JC07 Rec'd PCT/PTO 25 APR 2001

FORM PTO-1390 (REV 12-29-99)

U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
41569

US APPLICATION NO (If known, see 37 CFR 1 5)
09/830359

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/08376	November 3, 1999	November 5, 1998

TITLE OF INVENTION DEVICE AND METHOD FOR GENERATING A PARTIALLY SYNTHESIZED SIGNAL WITH VERY GOOD DYNAMIC QUALITY FOR THE ACCELERATION OF A ROTOR IN AN ELECTRICAL DRIVE MECHANISM

APPLICANT(S) FOR DO/EO/US
ANDREAS BOEHRINGER; RALPH SCHMIDT

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☑ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☑ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. ☑ is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ has been transmitted by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Of fice (RO/US).
6. ☑ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☑ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ have been transmitted by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - d. ☑ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☑ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Repor t under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☑ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☑ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☑ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information:

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U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/830359	PCT/EP99/08376	41569

	CALCULATIONS	PTO USE ONLY
17. ☑ The following fees are submitted: **BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :** Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .... **$1,000.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .... **$860.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... **$710.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) .... **$690.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	12 - 20 =	0	X **$18.00**	$	
Independent claims	1 - 3 =	0	X **$80.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$270.00**	$	
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction of 1/2 for filing by small entity, if applicable.				$	
SUBTOTAL =				$	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 40.00	
TOTAL FEES ENCLOSED =				$ 900.00	
				Amount to be refunded:	$
				charged:	$

a. ☑ A check in the amount of $ 900.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. ________ in the amount of $________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☑ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 18-2220. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

Roylance, Abrams, Berdo & Goodman, L.L.P.

1300 19th Street, N.W., Suite 600

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Mark S. Bicks

SIGNATURE

Mark S. Bicks

NAME

28,770

REGISTRATION NUMBER

09/830359

JC08 Rec'd PCT/PTO 25 APR 2001

41569

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	
	:	
ANDREAS BOEHRINGER ET AL.	:	PATENT
	:	
Serial No.: NEW	:	Group Art Unit:
	:	
Filed: Herewith	:	Examiner:
	:	
For: DEVICE AND METHOD FOR GENERATING A PARTIALLY SYNTHESIZED SIGNAL WITH VERY GOOD DYNAMIC QUALITY FOR THE ACCELERATION OF A ROTOR IN AN ELECTRICAL DRIVE MECHANISM	:	

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Preliminary to examination and calculation of the filing fee, please amend the above-identified application as follows:

In the Claims

8. A device and a process as described in Claim 2 , wherein the limit frequency value selected for the low-pass filter with low-pass transfer function FT(p) is low enough so that, if the drive winding is energized by multiphase current by

way of a so-called pulse inverter and its output voltage space indicator on the output side operates on the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z.

9. A device and a process as described in Claim 6, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function FT(p) is low enough so that, if the drive winding is energized by direct current by way of a so-called pulse inverter and its output voltage is derived in accordance with the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z.

10. A device and a process as described in Claim 1, wherein the low-pass filter with low-pass transfer function FT(p) is dimensioned so that its limit frequency is lower than 10 kHz.

11. A device and a process as described in Claim 1, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation $\alpha m = Fg(p)\ bEm$ and accordingly, in order for the actual conditions to be taken

into account is to be replaced by the relation αm = FM(p) Fg(p) bEm, in which transfer function FM(p) describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account by replacing the high-pass filter in question with the high-pass transfer function FH (p) = FT(0) FT(p) Fg(p) with a modified high-pass filter with modified high-pass transfer function Fh(p) = FT(0) - FT(p) Fg(p) FM(p), it being advisable in this process not to determine the limit frequency of the low-pass filter with low-pass transfer function FT(p) until the high-pass filter with high-pass transfer function FH (p) has been replaced by a modified high-pass filter with modified high-pass transfer function Fh(p).

12. A device and a process as described in Claim 1, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation αm = Fg(p) bEm and accordingly, in order for the actual conditions to be taken into account, is to be replaced by the relation αm = FM(p) Fg(p) Fg(p) bEm, in which transfer function FM(p) describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account in approximation

by separating from the transfer function in question FM(p) that part

$$F_0(p) = \frac{(1+p\cdot T_\mu)\cdot(1+2\cdot D_\nu\cdot p\cdot T_\nu+p^2\cdot T_\nu^2)\cdot\ldots}{(1+p\cdot T_i)\cdot(1+2\cdot D_j\cdot p\cdot T_j+p^2\cdot T_j^2)\cdot\ldots},$$

which allows for one or more poles and/or zero positions with particularly high values of $T\mu$, Tv, Ti, or Tj, and by replacing te high-pass filter in question with high-pass transfer function FH(p) = FT(0) - FT(p)   Fg(p) with a modified high-pass filter with modified high-pass transfer function Fh*(p) ≃ $F\gamma$(0) - FT(p)   F8(p)   F0(p), it being advisable not to determine the limit frequency of the low-pass filter with low-pass transfer function FT(p) in this process until the high-pass filter with high-pass transfer function FH(p) has been replaced by a modified high-pass filter with modified high-pass transfer function Fh*(p).

REMARKS

The above changes eliminate multiple dependency in the claims.

Respectfully submitted,

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Dated: April 24, 2001

Marked-up original claims

disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque from the position of the rotated part of the rotary acceleration meter at which the rotary thrust of the drive is engaged to the position of the rotated part of the accelerometer at which the effect used for registration of acceleration is generated, basis, is each scaled so that the relation $bm = \alpha \quad Fg(p) = bEm \quad Fg(p)$ is satisfied, and wherein the measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equalling 1, so that the signal $x = bm \quad FT(p)$ can be received at the output of the low-pass filter, and wherein the measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) - FT(p) \quad Fg(p)$, so that the signal $y = bEm \quad [FT(0) - FT(p) \quad Fg(p)]$ may be received at the output of this high-pass filter, and wherein a signal $z = bm \quad FT(p) + bEm \quad [FT(0) - FT(p) \quad Fg(p)]$ is formed in accordance with the relation $z = x + y$ and this synthesized signal z is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

7. A device and a process as described in Claim 6, wherein the armature current ia of the direct-current fed winding of the drive is used as substitute acceleration signal $bE = ia$ in place of the torque m of the drive.

8. A device and a process as described in Claim~~s~~ 2 ~~to 5~~, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function FT(p) is low enough so that, if the drive winding is energized by multiphase current by

way of a so-called pulse inverter and its output voltage space indicator on the output side operates on the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z.

9. A device and a process as described in ~~one of~~ Claim~~s~~ 6 ~~or 7~~, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function FT(p) is low enough so that, if the drive winding is energized by direct current by way of a so-called pulse inverter and its output voltage is derived in accordance with the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z.

10. A device and a process as described in ~~one of~~ Claim~~s~~ 1 ~~to 7~~, wherein the low-pass filter with low-pass transfer function FT(p) is dimensioned so that its limit frequency is lower than 10 kHz.

11. A device and a process as described in ~~one of~~ Claim~~s~~ 1 ~~to 10~~, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation $\alpha m = Fg(p)\ bEm$ and accordingly, in order for the actual conditions to be taken

into account is to be replaced by the relation αm = FM(p)   Fg(p)   bEm, in which transfer function FM(p) describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account by replacing the high-pass filter in question with the high-pass transfer function FH (p) = FT(0)   FT(p)   Fg(p) with a modified high-pass filter with modified high-pass transfer function Fh(p) = FT(0) - FT(p)   Fg(p)   FM(p), it being advisable in this process not to determine the limit frequency of the low-pass filter with low-pass transfer function FT(p) until the high-pass filter with high-pass transfer function FH (p) has been replaced by a modified high-pass filter with modified high-pass transfer function Fh(p).

12. A device and a process as described in ~~one of~~ Claim~~s~~ 1 ~~to 10~~, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation αm = Fg(p)   bEm and accordingly, in order for the actual conditions to be taken into account, is to be replaced by the relation αm = FM(p)   Fg(p)   Fg(p)   bEm, in which transfer function FM(p) describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account in approximation

by separating from the transfer function in question FM(p) that part

$$F_0(p) = \frac{(1+p\cdot T_\mu)\cdot(1+2\cdot D_v\cdot p\cdot T_v+p^2\cdot T_v^2)\cdot\ldots}{(1+p\cdot T_i)\cdot(1+2\cdot D_j\ p\cdot T_j+p^2\cdot T_j^2)\cdot\ldots},$$

which allows for one or more poles and/or zero positions with particularly high values of Tμ, Tv, Ti, or Tj, and by replacing te high-pass filter in question with high-pass transfer function FH(p) = FT(0) - FT(p) Fg(p) with a modified high-pass filter with modified high-pass transfer function Fh*(p) ≃ Fγ(0) - FT(p) F8(p) F0(p), it being advisable not to determine the limit frequency of the low-pass filter with low-pass transfer function FT(p) in this process until the high-pass filter with high-pass transfer function FH(p) has been replaced by a modified high-pass filter with modified high-pass transfer function Fh*(p).

ITC

INTERNATIONAL TRANSLATION CENTER, INC.

DECLARATION OF TRANSLATOR

I, Lawrence B. Hanlon, of the International Translation Center, Inc., do hereby avow and declare that I am conversant with the English and German languages and am a competent translator of German into English. I declare further that to the best of my knowledge and belief the following is a true and correct translation prepared and reviewed by me of the document in the German language attached hereto.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the attached patent application or any patent issued thereon.

Lawrence B. Hanlon

Lawrence B. Hanlon

Date: April 6, 2001

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Device and process for generation of a partly synthesized high-quality signal for acceleration of an armature of an electric drive

In order to design high-quality position or speed control for a rotary or linear electric drive it has been customary in the past to control the components directly generating torque or force in the innermost loop, that is, in cascade control [1;2]. The most recent developments [3;4] have shown that on the other hand it is highly advantageous not to control the torque or force generating components of the current volume indicators indirectly but to guide the acceleration of the part propelled, that is, in cascade control. In the case of rotary drives this is the spin of the rotor and in the case of linear drives the linear acceleration of the armature. Hence use of an accelerometer is required for registration of these values, for example, an accelerometer which operates on the Ferraris principle [3;4;5]. For one thing, however, this accelerometer on the whole is characterized by a delay in measurement, albeit a small one. For another, this accelerometer can never be completely rigidly connected to the place engaged by rotary thrust in the case of a rotary drive or by linear thrust in the case of a linear drive. The result of these two facts is that loop limit cycles and/or self-excited oscillations are formed in the cascade control loop for the acceleration [4]. Unless these limit cycles and/or self-excited oscillations are prevented, use of such a cascade control loop is not successful for high-quality position or speed control. A process for suppression of these limit cycles and/or self-excited oscillations in the cascade control loop for acceleration has been proposed for rotary drives [4]. However, this process has the disadvantage that its application is

extremely costly and in addition that it reacts with extreme sensitivity to fluctuations in the parameters of the drive.

A partly synthesized signal of high dynamic quality for acceleration of an armature of an electric drive can be generated by means of the device claimed for the invention as proposed here. Cascade control of acceleration can be achieved by means of this signal, to a great extent independently of the parameters of the drive, while limit cycles and/or self-excited oscillations are prevented in this cascade acceleration control loop.

A partly synthesized signal of high dynamic quality can be generated with a device as described in Claims 1-12.

For the purpose of generating a high-quality signal for acceleration of an electric drive, first the acceleration signal $bm = \alpha \quad Fg(p)$, in which $Fg(p)$ describes the measurement transfer function, is registered and then the torque m or the propulsive force f as substitute acceleration signal $bEm = m$ or $bEm = f$ and, all losses arising throughout propulsion being disregarded and the basis adopted being that of an absolutely rigid connection of the surface engaged by the thrust of the drive to the place at which the effect used for registration of acceleration is used, is scaled so that the relation $bm = \alpha \quad Fg(p) - bEm \quad Fg(p)$ is satisfied. The acceleration signal $bm = \alpha \quad Fg(p)$ is taken to a low-pass filter with the low-pass transfer function $FT(p)$; hence the signal $x = bm \quad FT(p)$ is present at the output of the filter and the substitute acceleration signal becomes a high-pass filter with the high-pass transfer function $FH(p) = FT(0) - FT(p) \quad Fg(p)$, adjacent to the output of which is the signal $y = bEm = \alpha \quad Fg(p) \; [FT(0) - FT(p) \quad Fg(p)]$. Lastly, the synthesized signal $z + y$ is formed; it is used as a substitute signal of high

dynamic quality for the instantaneous armature acceleration value in automatic control of the drive.

For this purpose, in the case of rotary current propulsion the rotary acceleration α of the rotated armature is registered metrologically by an accelerometer [3;4;5] connected to this armature and preferably operating on the Ferraris principle, and is consequently available as measured acceleration signal bm - α Fg(p). Fg(p), with Fg(0) = 1, here represents the so-called measurement transfer function of the accelerometer. The torque m of the drive, hereafter designated as substitute acceleration signal bE = m, is also registered metrologically and accordingly is available as measured substitute acceleration signal bE = m. As is to be immediately perceived, use may of course be made, without impairing the operation of the device claimed for the invention, in place of the torque m of the drive, also directly of the torque-forming transverse-current components iq of the current volume indicator of the rotary current fed winding of the drive as substitute acceleration signal bE = iq. In what follows, as is customary in metrology, it is assumed that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation bm = α Fg(p) = bEm Fg(p) is satisfied. The measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equaling 1. Hence the signal x = bm FT(p) can be received at the output of the low-pass

filter. The measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) - FT(p) \quad Fg(p)$. Consequently, the signal $y = bEm \quad [FT(0) - FT(p) \quad Fg(p)]$ may be received at this high-pass filter. A signal $z = bm \quad FT(p) + bEm \quad [FT(0) - FT(p) \quad Fg(p)]$ is now formed in accordance with the relation $z = x + y$. This synthesized signal is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

In the case of a traveling-wave drive the linear acceleration α of an armature in linear movement is metrologically registered by means of an accelerometer mechanically connected to this armature, one preferably operated on the Ferraris principle transposed to linear movement, and is accordingly available as measured acceleration signal $bm = \alpha \quad Fg(p)$. In this instance $Fg(p)$, with $Fg(0) = 1$, represents the so-called measurement transfer function of the accelerometer. The linear force f of the drive, to be designated in what follows as substitute acceleration signal $bE = f$, is also registered metrologically and is accordingly available as measured substitute acceleration signal bEm. As is to be immediately perceived, without impairing the operation of the device claimed for the invention, the transverse-current component iq immediately forming the linear force of the current volume indicator of the multiphase current-fed winding of the drive may be used as substitute acceleration signal $bE = iq$. It is assumed in what follows, as is customary in control engineering, that both the measured acceleration signal bm and the substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid

connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation bm = α Fg(p) = bEm Fg(p) is satisfied. The measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equaling 1. Hence the signal x = bm FT(p) can be received at the output of the low-pass filter. The measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function FH(p) = FT(0) - FT(p) Fg(p). Consequently, the signal y = bEm [FT(0) - FT(p) Fg(p)] may be received at the output of this high-pass filter. A signal z = bm FT(p) + bEm [FT(0) - FT(p) Fg(p)] is now formed in accordance with the relation z = x + y. This synthesized signal is subsequently used as a very high-quality dynamic substitute for the undelayed instantaneous value of rotary acceleration α of the rotated armature in automatic control of the drive in question.

In the case of direct-current propulsion the rotary acceleration α of the rotated armature is registered metrologically by an accelerometer [3;4;5] connected to this armature and preferably operating on the Ferraris principle, and is consequently available as measured acceleration signal bm - α Fg(p). Fg(p), with Fg(0) = 1, here represents the so-called measurement transfer function of the accelerometer. The torque m of the drive, hereafter designated as substitute acceleration signal bE = m, is also registered metrologically and accordingly is available as measured substitute acceleration signal bEm. As is to be perceived immediately, use may of course be made, without impairing the operation of the device claimed for the

invention, in place of the torque m of the drive, also directly of the armature current ia of the direct-current fed winding of the drive as substitute acceleration signal bE = ia. In what follows, as is customary in metrology, it is assumed that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation $bm = \alpha \;\; Fg(p) = bEm \;\; Fg(p)$ is satisfied. The measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equaling 1. Hence the signal $x = bm \;\; FT(p)$ can be received at the output of the low-pass filter. The measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) - FT(p) \;\; Fg(p)$. Consequently, the signal $y = bEm \;\; [FT(0) - FT(p) \;\; Fg(p)]$ may be received at this high-pass filter. A signal $z = bm \;\; FT(p) + bEm \;\; [FT(0) - FT(p) \;\; Fg(p)]$ is now formed in accordance with the relation $z = x + y$. This synthesized signal is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

The device and the process for obtaining a partly synthesized signal of high dynamic value for acceleration of the armature of a machine is explained in detail in what follows on the basis of an example of a separately excited direct-current machine and with reference to the drawings in Figures 1 to 4.

It is advantageous for design of high-quality position or speed control for a separately excited direct-current machine to control rotary acceleration of the armature rather than the armature current in the innermost loop. For this purpose the rotary acceleration α of the rotor is registered by an accelerometer, preferably one operating on the Ferraris principle, and is accordingly available as measured rotary acceleration bm = α Fg(p). Block 1 (see Figures 1,2,3, and 4) with transfer function Fg(p), with Fg(0) = 1, describes the so-called measurement frequency response of the accelerometer. The torque m of the drive, which in what follows is designated as substitute acceleration signal bE = m, is also registered metrologically and accordingly is available as measured substitute acceleration signal bEm. Armature current Ia of the direct-current-fed armature winding of the drive may, of course, also be used as substitute acceleration signal bE = ia in place of the moment m of the drive. In what follows, as is customary in control engineering, it is assumed that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation bm = α Fg(p) = bEm Fg(p) is satisfied. The measured acceleration signal bm is delivered to the input of a low-pass filter 2 (see Figures 1,2,3, and 4) with the low-pass transfer function FT(p), FT(0) preferably equaling 1. Hence the signal x = bm FT(p) can be received at the output of the low-pass filter. The measured substitute acceleration signal ibm is delivered to the input of a high-pass filter 3 (see Figures 1 and

2) with high-pass transfer function FH(p) = FT(0) - FT(p) Fg(p). Consequently, the signal y = bEm [FT(0) - FT(p) Fg(p)] may be received at this high-pass filter. A signal z = bm FT(p) + bEm [FT(0) - FT(p) Fg(p)] is now formed in accordance with the relation z = x + y. This synthesized signal is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question. The difference between the set value αsoll assigned by a superimposed control system and the synthesized signal z is delivered to a suitable control unit 4 as control difference (see Figure 1). Delay of the measurement transfer function Fg(p) and the considerable disturbance of the transfer function FM(p) are eliminated from the control frequency response, which is of decisive importance for stability, possible limiting cycles, and self-excited oscillations. The last-named transfer function, FM(p), describes the mechanical frequency response between the surface of the armature moved which is engaged by the thrust of the drive and the position of the moved part of the accelerometer at which the effect used for registration of acceleration is generated. The low-pass filter with low-pass transfer function Fγ(p) almost entirely eliminates the influence of this mechanical frequency response. So long as transfer function FM(p) does not deviate significantly from value 1, damping of the low-pass filter does not exhibit significant values. But starting with the limit frequency of the low-pass filter the damping rises sharply, so that the unavoidable resonance step-ups of the mechanical frequency response virtually exert no more influence. The delay of the acceleration signal bm by the measurement transfer function Fg(p) and the delay additionally caused by the low-pass filter are entirely eliminated by signal y = bEm FH(p) at the output of the high-pass filter in the frequency response

in question of the control loop formed by means of the synthesized signal z.

The procedure claimed for the invention as presented is also described by the block diagram in Figure 1. The first-order delay element 5 (see Figures, 1,2,3, and 4) with amplification VR and time constant TE describes the delayed reaction of the armature current ia to change in voltage at the input of the delay element.

In a preferred embodiment the output voltage of the pulse inverter which feeds the armature winding of the drive is derived directly from a two-point control loop [6], on the principle of the discrete-time switching condition control with a clock frequency fA = 1/*TA* in the 100-kHz range. Consequently, in Figure 2 the controller 4 is replaced by the two-point element 6, a scanning element 7 with scanning frequency fA = 1/*TA*, and a zero-order holding element 8. Amplifications V and -V in the two-point element 6 take the ratio of converter output voltage to rated voltage of the machine into account. The scanning element 7 and the zero-order holding element 8 allow for the effect of discrete-time switching condition control. In this embodiment of the device claimed for the invention the limit frequency selected for the low-pass filter 2 with low-pass transfer function FT(p) is to be low enough that no self-excited oscillations occur in the two-point control circuit for synthesized signal z.

Should the circumstance frequently occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation αm - Fg(p) bEM prove to be a source of disturbance for the quality of the two-

point cascade control, the process claimed for the invention is expanded. This expansion is characterized by the block diagram in Figure 3. In this instance the transfer function FM(p) 9 describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated. The relationship between the substitute acceleration signal bEm and the measured acceleration αm is accordingly expressed as αm = FM(p) Fg(p) bEM. This mechanical frequency response with transfer function FM(p) 9 (see Figures 3 and 4) is now taken into account in that the high-pass filter 3 with high-pass transfer function FH (p) = FT(0) - FT(p) Fg(p) is replaced by a modified high-pass filter 10 with modified high-pass transfer function Fh(p) = FT(0) - FT(p) Fg(p) FM(p). It is advisable in this process not to determine the limit frequency of the low-pass filter 2 with low-pass transfer function FT(p) until the high-pass filter 3 with high-pass transfer function FH (p) has been replaced by modified high-pass filter 10 with modified high-pass transfer function Fh(p).

Should the transfer function FM(p) have a plurality of polar and/or zero positions, development of the high-pass filter 10 with modified high-pass transfer function Fh(p) is found to be very costly. In order to reduce this cost in development of this high-pass filter 10, the process claimed for the invention may be further modified as described in the following. A part

$$F_0(p) = \frac{(1+p\cdot T_\mu)\cdot(1+2\cdot D_v\cdot p\cdot T_v+p^2\cdot T_v^2)\cdot\ldots}{(1+p\cdot T_i)\cdot(1+2\cdot D_j\cdot p\cdot T_j+p^2\cdot T_j^2)\cdot\ldots}$$

is separated from the transfer function of the mechanical frequency response. This part allows for one or more poles

and/or zero positions with particularly high values of $T\mu$, Tv, Ti, or Tj. The transfer function of the mechanical frequency response may be described as follows

$$F_M(p) = F_0(p) \cdot F_{M,Rest}(p) \text{ mit } F_{M,Rest}(p) = F_M(p) \cdot F_0^{-1}(p).$$

The mechanical frequency response with transfer function FM(p) 9 is now taken into account only in approximation by the circumstance that the high-pass filter 3 with high-pass transfer function FH(p) = FT(0) - FT(p) Fg(p) is replaced by a modified high-pass filter 11 with modified high-pass transfer function Fh*(p) ≃ $F\gamma$(0) - FT(p) F[-](p) F0(p). It is advisable not to determine the limit frequency of the low-pass filter 2 with low-pass transfer function FT(p) in this process until the high-pass filter 3 with high-pass transfer function FH(p) has been replaced by modified high-pass filter 11 with modified high-pass transfer function Fh*(p). The proposed process claimed for the invention is described by the block diagram in Figure 4.

[References]

[1] Leonhard, W., Electric variable speed drives for mechanical engineering, state of the art, trends in development, (Electrische Regelantriebe für den Maschinenbau, Stand der Technik, Entwicklungstendenzen. VDI [Association of German Engineers]-Zeitschrift (1981), No. 10

[2] Weck, M., Krüger, P., Brecher, C., Remy, F., Statistical and dynamic rigidity of linear direct drives, (Statische und dynamische Steifigkeit von linearen Direktantrieben) antriebstechik 36 (1997), No. 12, pp. 57-63

[3] Schwarz, B., Contributions to rapid-reaction and high-accuracy rotary current positioning systems, (Beiträge zu reaktionsschnellen und hochgenauen Drehstrom-Positioniersystemen) Dissertation, University of Stuttgart, 1986.

[4] Gambach, H. Servo drives with two-point cascade control of their rotary acceleration, [Servoantriebe mit unterlagerter Zweipunktregelung ihrer Drehbeschleunigung], Dissertation, University of Stuttgart, 1993.

[5] EP 0 661 543 B1, Transmitter system for determination of at least one of three quantities: rotary acceleration, angular velocity, or angular position of a rotating component. [Gebersystem zur Ermittlung wenigstens einer der drei Größen Drehbeschleunigung, Winkelgeschwindigkeit oder Winkellage eines rotierenden Bauteils].

[6] Boehringer, A., Setting of switching states in power electronics actuators by the directly desired effect [Einstellung der Schaltzustände in Stellgliedern der Leistungselektronik], etzArchiv, Vol. 11 (1989), No. 12, pp. 381-388.

Claims

1. Device and process for generation of a partly synthesized high-quality signal for acceleration of an armature of an electric drive, characterized in that the rotary acceleration α of the rotated armature or, in the case of a travelling wave drive with armature set in linear movement, the linear acceleration α of the armature set in linear movement, is registered metrologically by an accelerometer mechanically connected to this armature and preferably operating on the Ferraris principle, or, in the case of a travelling wave drive with armature set in linear movement by an accelerometer preferably operating on the Ferraris principle transposed to linear movement and is consequently available as measured acceleration signal $bm = \alpha \quad Fg(p)$. $Fg(p)$, with $Fg(0) = 1$, here representing the so-called measurement transfer function, and in that the torque m, or in the case of a travelling wave drive with armature set in linear movement, the linear force f of the drive hereinafter designated as substitute acceleration signal $bE = m$, or in the case of a traveling wave drive with an armature set in linear movement, designated as substitute acceleration signal $bE = f$, is also registered metrologically and accordingly is available as measured substitute acceleration signal bEm, it being assumed thereafter, as is customary in automatic control engineering, that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is

generated being taken as a basis, or, in the case of a travelling wave drive with armature set in linear movement, a mechanically absolutely rigid connection from the surface of the armature set in linear movement which is engaged by the linear thrust of the drive to the position of the part of the linear accelerometer at which the effect used for registration of acceleration is registered, is each scaled so that the relation bm = α Fg(p) = bEm   Fg(p) is satisfied, and characterized in that the measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equalling 1, so that the signal x = bm   FT(p) can be received at the output of the low-pass filter, and in that the measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function FH(p) = FT(0) - FT(p)   Fg(p), and so the signal y = bEm [FT(0) - FT(p)   Fg(p)] may be received at this high-pass filter, and in that a signal z = bm   FT(p) + bEm   [FT(0) - FT(p) Fg(p)] is now formed in accordance with the relation z = x + y and this synthesized signal z is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question or, in the case of a travelling wave drive with armature set in linear movement, as a very high-quality dynamic substitute as the undelayed instantaneous value of the linear acceleration α of the armature set in linear movement in automatic control of the drive in question.

2. A device and a process as described in Claim 1, wherein the rotary acceleration α of the rotated armature of a rotary current drive is registered metrologically by an accelerometer mechanically connected to this armature and preferably operating

on the Ferraris principle, and is consequently available as measured acceleration signal $bm - \alpha \quad Fg(p)$. $Fg(p)$, with $Fg(0) = 1$, here representing the so-called measurement transfer function, and wherein the torque m, hereinafter designated as substitute acceleration signal $bE = m$, is registered metrologically and accordingly is available as measured substitute acceleration signal bEm, it being assumed thereafter, as is customary in automatic control engineering, that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque to the position of the rotated part of the rotary acceleration meter at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation $bm = \alpha \quad Fg(p) = bEm \quad Fg(p)$ is satisfied, and wherein the measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function $FT(p)$, $FT(0)$ preferably equalling 1, so that the signal $x = bm \quad FT(p)$ can be received at the output of the low-pass filter, and wherein the measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) \quad FT(p) \quad Fg(p)$, and so the signal $y = bEm \quad [FT(0) - FT(p) \quad Fg(p)]$ may be received at this high-pass filter, and wherein a signal $z = bm \quad FT(p) + bEm \quad [FT(0) - FT(p) \quad Fg(p)]$ is now formed in accordance with the relation $z = x + y$ and this synthesized signal is subsequently used as a very high-quality dynamic substitute for the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

3. A device and a process as described in Claim 2, wherein, rather than the torque m of the drive, use is made of the directly torque forming transverse-current component iq of the current volume indicator of the winding fed by transverse current of the drive substitute acceleration signal bE = iq.

4. A device and a process as described in Claim 1, wherein the linear acceleration α of an armature set in linear movement of a travelling wave drive is registered metrologically by an accelerometer preferably operating on the Ferraris principle transposed to linear movement and is consequently available as measured acceleration signal $bm = \alpha \quad Fg(p)$, $Fg(p)$, with $Fg(0) = 1$, representing the so-called measurement transfer function, and wherein the linear force f of the drive with armature set in linear movement, hereinafter designated as substitute acceleration signal bE = f, is also registered metrologically and accordingly is available as measured substitute acceleration signal bEm, it being assumed thereafter, as is customary in automatic control engineering, that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being disregarded and a mechanically absolutely rigid connection of the surface of the armature set in linear movement engaged by the linear thrust to the position of the part of the linear acceleration meter in linear movement at which the effect used for registration of acceleration is generated being taken as a basis, is each scaled so that the relation
$bm = \alpha \quad Fg(p) = bEm \quad Fg(p)$ is satisfied, and wherein the measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equalling 1, so that the signal $x = bm \quad FT(p)$ can be received at the output of the low-pass filter, and wherein the

measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function $FH(p) = FT(0) - FT(p) \quad Fg(p)$, and so the signal $y = bEm \; [FT(0) - FT(p) \quad Fg(p)]$ may be received at the output of this high-pass filter, and wherein a signal $z = bm \quad FT(p) + bEm \; [FT(0) - FT(p) \quad Fg(p)]$ is now formed in accordance with the relation $z = x + y$ and this synthesized signal z is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the linear acceleration α of the armature in linear movement in automatic control of the drive in question.

5. A device and process as described in Claim 4, wherein the transverse-current component iq directly forming the linear force of the current volume indicator of the multiphase current-fed winding of the drive is used as substitute acceleration signal $bE = iq$ in place of linear force f of the drive.

6. A device and a process as described in Claim 1, wherein the rotary acceleration α of the rotated armature of a direct-current drive is registered metrologically by an accelerometer connected to this armature and preferably operating on the Ferraris principle, and is consequently available as measured acceleration signal $bm = \alpha \quad Fg(p)$, $Fg(p)$, with $Fg(0) = 1$, here representing the so-called measurement transfer function of the accelerometer, and wherein the torque m of the drive, hereafter designated as substitute acceleration signal $bE = m$, is also registered metrologically and accordingly is available as measured substitute acceleration signal bEm, it being assumed thereafter that on the one hand the measured acceleration signal bm and on the other the measured substitute acceleration signal bEm, all losses occurring in the drive in question being

disregarded and a mechanically absolutely rigid connection of the surface of the armature rotated engaged by the torque from the position of the rotated part of the rotary acceleration meter at which the rotary thrust of the drive is engaged to the position of the rotated part of the accelerometer at which the effect used for registration of acceleration is generated, basis, is each scaled so that the relation bm = α Fg(p) = bEm   Fg(p) is satisfied, and wherein the measured acceleration signal bm is delivered to the input of a low-pass filter with the low-pass transfer function FT(p), FT(0) preferably equalling 1, so that the signal x = bm   FT(p) can be received at the output of the low-pass filter, and wherein the measured substitute acceleration signal bEm is delivered to the input of a high-pass filter with high-pass transfer function FH(p) = FT(0) - FT(p) Fg(p), so that the signal y = bEm   [FT(0) - FT(p)   Fg(p)] may be received at the output of this high-pass filter, and wherein a signal z = bm   FT(p) + bEm   [FT(0) - FT(p)   Fg(p)] is formed in accordance with the relation z = x + y and this synthesized signal z is subsequently used as a very high-quality dynamic substitute as the undelayed instantaneous value of the rotary acceleration α of the rotated armature in automatic control of the drive in question.

7. A device and a process as described in Claim 6, wherein the armature current ia of the direct-current fed winding of the drive is used as substitute acceleration signal bE = ia in place of the torque m of the drive.

8. A device and a process as described in Claims 2 to 5, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function FT(p) is low enough so that, if the drive winding is energized by multiphase current by

way of a so-called pulse inverter and its output voltage space indicator on the output side operates on the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z.

9. A device and a process as described in one of Claims 6 or 7, wherein the limit frequency value selected for the low-pass filter with low-pass transfer function FT(p) is low enough so that, if the drive winding is energized by direct current by way of a so-called pulse inverter and its output voltage is derived in accordance with the principle of discrete-time change in switching condition control with a clock frequency in the 100-kHz range directly from a two-point control loop which adjusts the instantaneous value of the synthesized signal z to the set value of this signal, then no self-excited oscillations arise in this two-point control loop for the synthesized signal z.

10. A device and a process as described in one of Claims 1 to 7, wherein the low-pass filter with low-pass transfer function FT(p) is dimensioned so that its limit frequency is lower than 10 kHz.

11. A device and a process as described in one of Claims 1 to 10, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation $\alpha m = Fg(p)\ \ bEm$ and accordingly, in order for the actual conditions to be taken

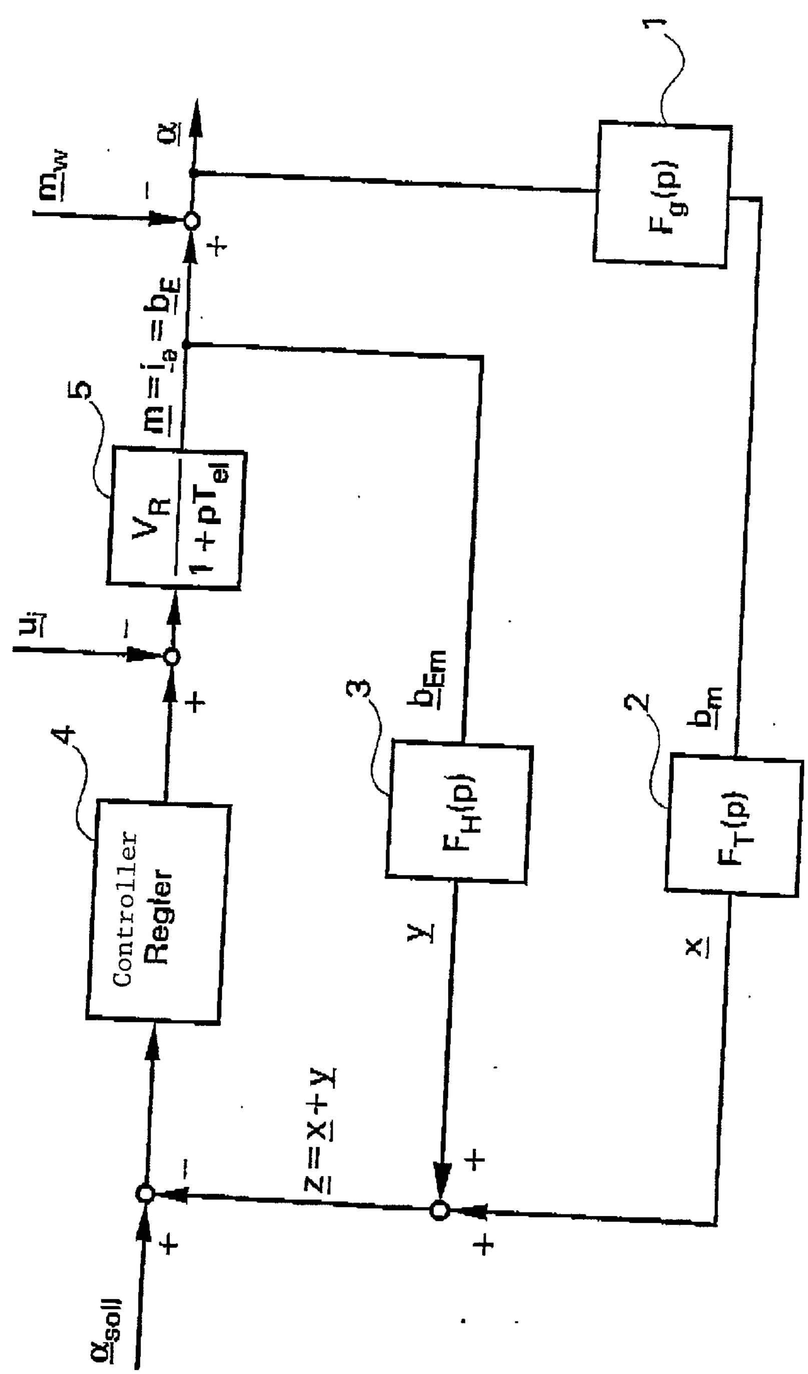
into account is to be replaced by the relation αm = FM(p) Fg(p) bEm, in which transfer function FM(p) describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account by replacing the high-pass filter in question with the high-pass transfer function FH (p) = FT(0) FT(p) Fg(p) with a modified high-pass filter with modified high-pass transfer function Fh(p) = FT(0) - FT(p) Fg(p) FM(p), it being advisable in this process not to determine the limit frequency of the low-pass filter with low-pass transfer function FT(p) until the high-pass filter with high-pass transfer function FH (p) has been replaced by a modified high-pass filter with modified high-pass transfer function Fh(p).

12. A device and a process as described in one of Claims 1 to 10, wherein the circumstance constantly occurring in practical application that the connection between the measured substitute acceleration signal bEm and the measured acceleration signal αm is only incompletely described by the equation αm = Fg(p) bEm and accordingly, in order for the actual conditions to be taken into account, is to be replaced by the relation αm = FM(p) Fg(p) Fg(p) bEm, in which transfer function FM(p) describes the mechanical frequency response from the surface of the armature set in movement which is engaged by the thrust of the drive to the position of the part of the accelerometer set in movement at which the effect used for registration of acceleration is generated is taken into account in approximation

by separating from the transfer function in question FM(p) that part

$$F_0(p) = \frac{(1+p\cdot T_\mu)\cdot(1+2\cdot D_\nu\cdot p\cdot T_\nu+p^2\cdot T_\nu^2)\cdot\ldots}{(1+p\cdot T_i)\cdot(1+2\cdot D_j\cdot p\cdot T_j+p^2\cdot T_j^2)\cdot\ldots},$$

which allows for one or more poles and/or zero positions with particularly high values of $T\mu$, Tv, Ti, or Tj, and by replacing te high-pass filter in question with high-pass transfer function FH(p) = FT(0) - FT(p) Fg(p) with a modified high-pass filter with modified high-pass transfer function Fh*(p) $\simeq$ Fγ(0) - FT(p) F8(p) F0(p), it being advisable not to determine the limit frequency of the low-pass filter with low-pass transfer function FT(p) in this process until the high-pass filter with high-pass transfer function FH(p) has been replaced by a modified high-pass filter with modified high-pass transfer function Fh*(p).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Regler
V_R / 1 + pT_el
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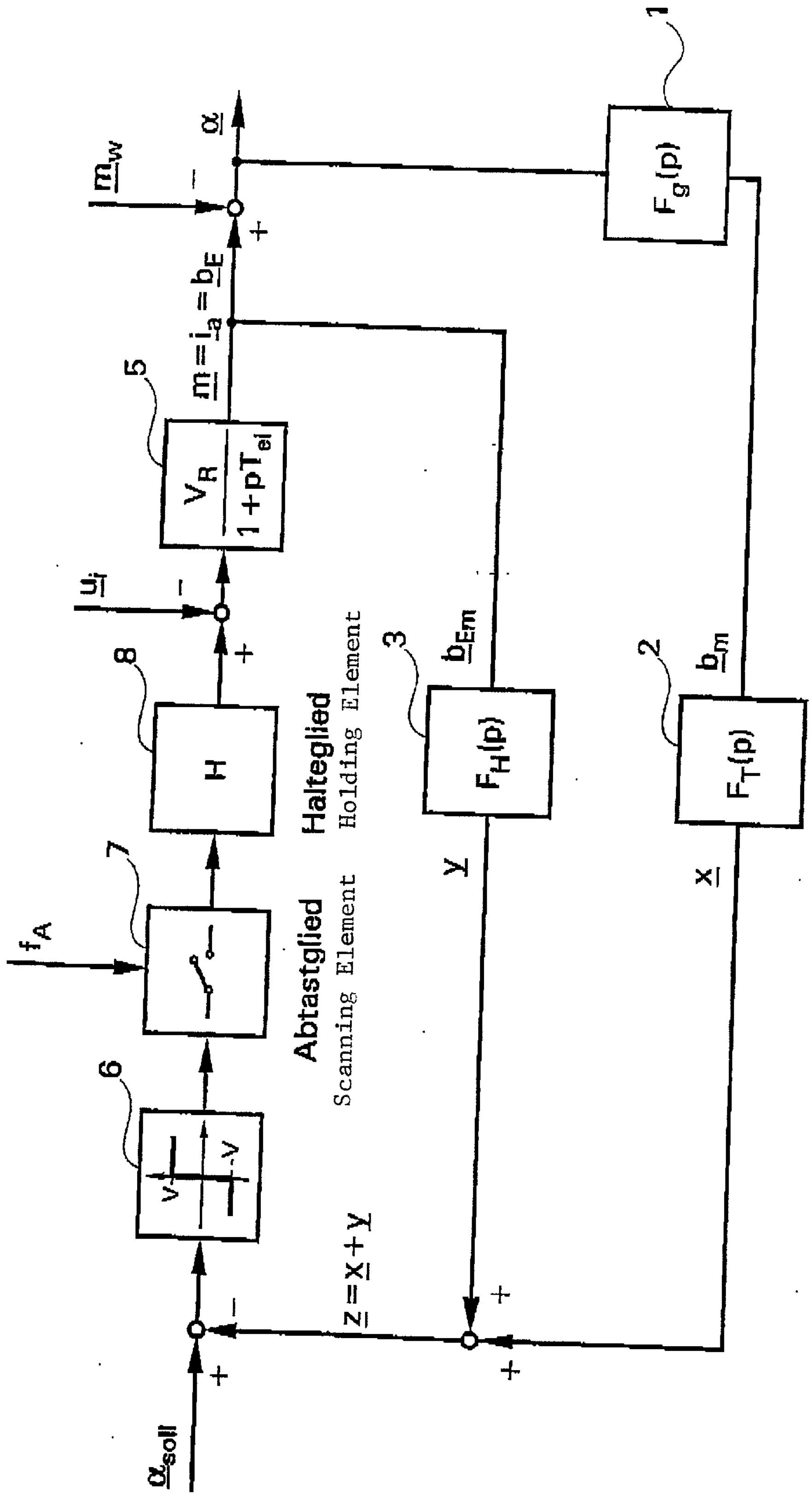
m_w
α
F_g(p)
F_H(p)
F_T(p)
b_Em
b_m
u_i
y
x
z = x + y
α_soll
1
2
3
4
5

Fig. 1


1
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$F_g(p)$
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$\underline{m}=\underline{i}_a=\underline{b}_E$
$\underline{u}_i$
f_A
Halteglied
Holding Element
Abtastglied
Scanning Element
$\underline{b}_{Em}$
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$\underline{y}$
$\underline{x}$
$\underline{z}=\underline{x}+\underline{y}$
$\underline{\alpha}_{soll}$

Fig. 2

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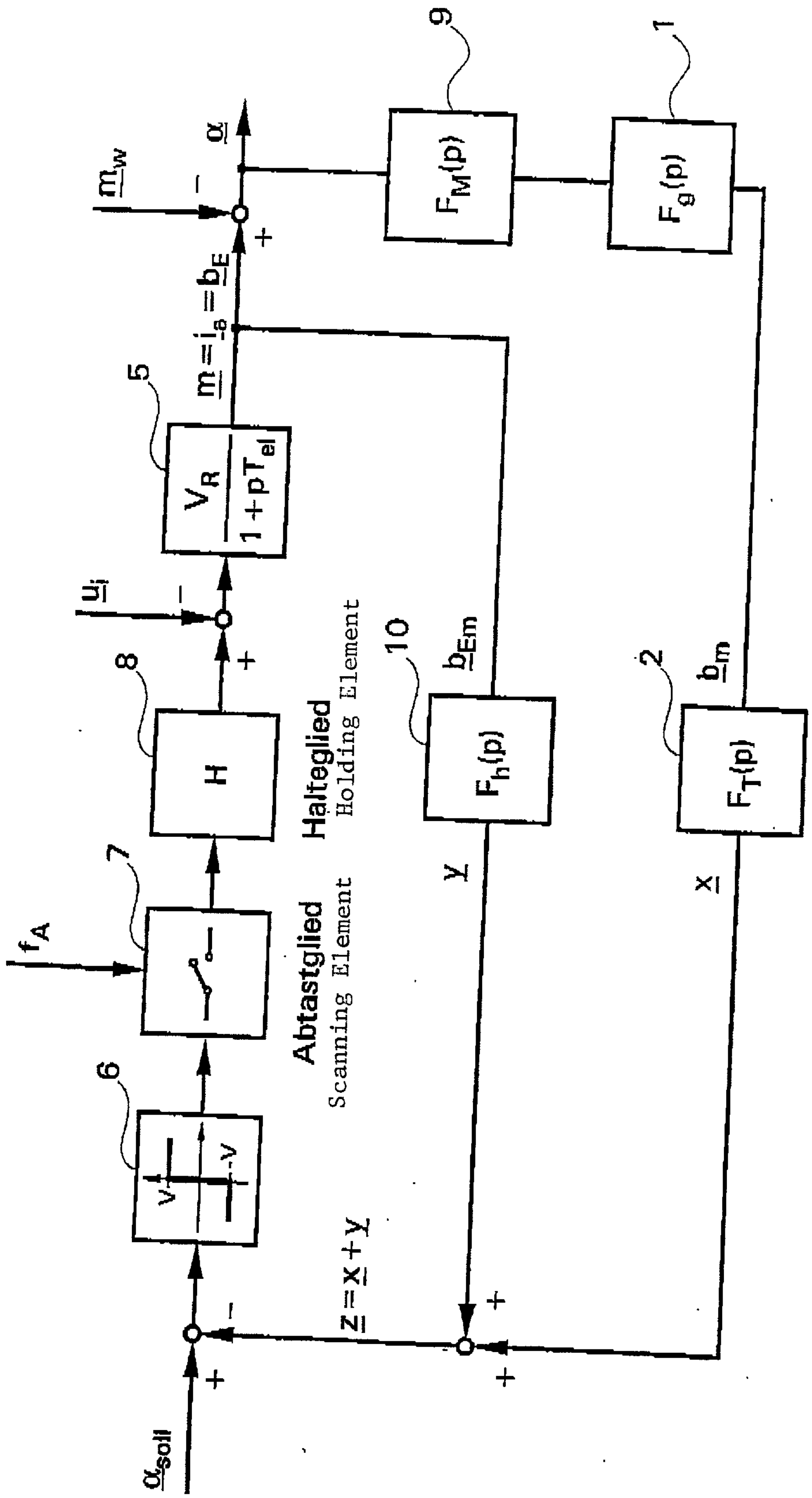
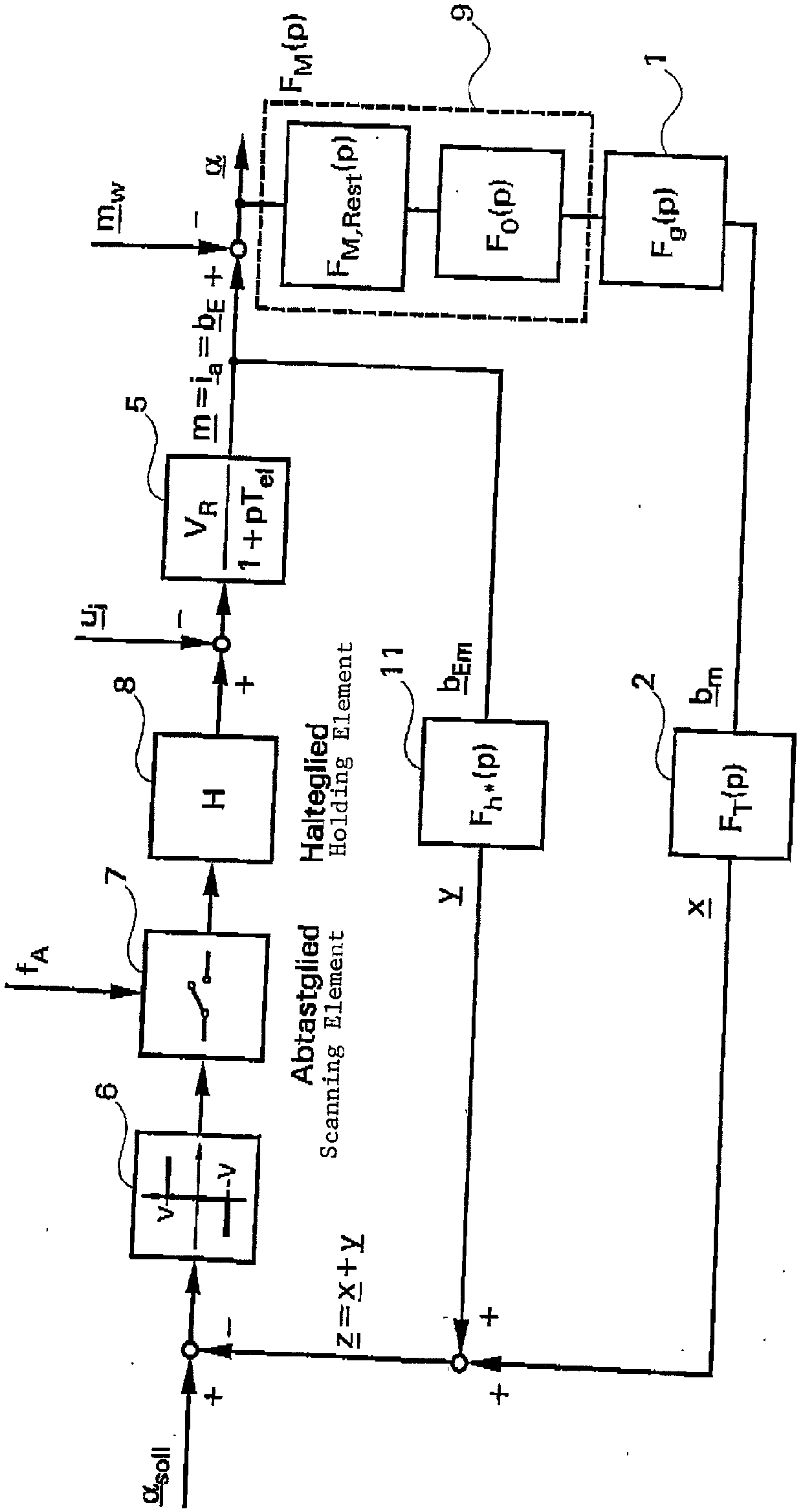


Fig. 3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$\underline{z}=\underline{x}+\underline{y}$
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v
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f_A
7
Abtastglied
Scanning Element
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Halteglied
Holding Element
$\underline{u}_i$
5
$\frac{V_R}{1+pT_{el}}$
$\underline{m}=\underline{i}_a=\underline{b}_E$
$\underline{m}_w$
$\underline{\alpha}$
$F_M(p)$
9
$F_{M,Rest}(p)$
$F_0(p)$
1
$F_g(p)$
11
$\underline{b}_{Em}$
$F_{h*}(p)$
$\underline{y}$
2
$\underline{b}_m$
$F_T(p)$
$\underline{x}$

Fig. 4

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DECLARATION AND POWER OF ATTORNEY

We declare:

(1) That I, Christa Boehringer, am a citizen of Austria, residing at Hasenbergstiege 55A, D-70197 Stuttgart, Germany, that I am executing this declaration on behalf of and as legal representative of Andreas Boehringer, now deceased, a citizen of Germany, formerly residing at Hasenbergstiege 55A, D-70197 Stuttgart, Germany;

(2) That I, Ralph Schmidt, am a citizen of Germany, residing at Laimgruber Strasse 29, D-83365 Sondermoning, Germany;

That we have read the foregoing specification and claims, and upon information and belief, we verily believe that Andreas Boehringer and Ralph Schmidt are the original, first and joint inventors of the invention entitled DEVICE AND METHOD FOR GENERATING A PARTIALLY SYNTHESIZED SIGNAL WITH VERY GOOD DYNAMIC QUALITY FOR THE ACCELERATION OF A ROTOR IN AN ELECTRICAL DRIVE MECHANISM described and claimed therein; that we have reviewed and understand the content of the attached specification, including the claims; that we acknowledge our duty to disclose information of which we are aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a) and that no application for patent or inventor's certificate on this invention has been filed by Andreas Boehringer or Ralph Schmidt or their representatives or assigns in any country foreign to the United States except as follows for which priority is claimed:

German Application No. 198 51 003.9 filed November 5, 1998;
PCT Application No. PCT/EP99/08376 filed November 3, 1999.

And we hereby appoint:

David S. Abrams	Reg. No. 22,576	Joseph J. Buczynski	Reg. No. 35,084
Alfred N. Goodman	Reg. No. 26,458	Jeffrey J. Howell	Reg. No. 46,402
Mark S. Bicks	Reg. No. 28,770	Tara L. Hoffman	Reg. No. 46,510
John E. Holmes	Reg. No. 29,392	Marcus R. Mickney	Reg. No. 44,941
Lance G. Johnson	Reg. No. 32,531	Christian C. Michel	Reg. No. 46,300
Garrett V. Davis	Reg. No. 32,023	Aisha Ahmad	Reg. No. 47,381
Stacey J. Longanecker	Reg. No. 33,952		

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of the firm of ROYLANCE, ABRAMS, BERDO & GOODMAN, L.L.P. as our attorneys or agents with full power of substitution and revocation, to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

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The undersigned further declare that all statements made herein of their own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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